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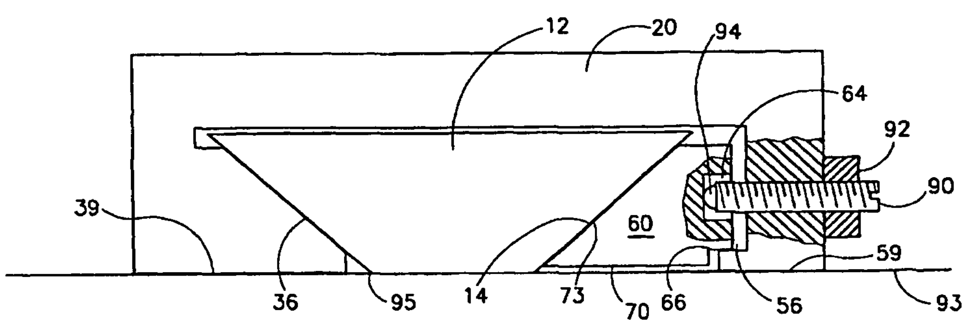
(54) Title: OPTICAL ALIGNMENT AND MOUNTING SYSTEM



(57) Abstract

An optical alignment and mounting system comprising: a mounting element (20) on which at least on optical component (100) is mounted; a flat surface (93) which provides a vertical reference for the mounting element; a rail (12) mounted on the flat surface on which the mounting element is mounted and which provides a horizontal reference for the mounting element.

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OPTICAL ALIGNMENT AND MOUNTING SYSTEM

FIELD OF THE INVENTION

The present invention relates to the mounting of components in an optical system and in particular to the alignment and mounting of replaceable, "factory-aligned" components in an optical system.

BACKGROUND OF THE INVENTION

Alignment is of prime importance in optical systems, especially where laser light is used.

Often, system components are set up on a very flat granite table. The granite table provides vertical alignment (denoted herein as the y axis). Components which are referenced to their base are thus at a fixed height from a common reference.

In some optical systems the components are mounted on an optical bench or rail. This mounting assures both vertical (y-axis) and horizontal (x-axis) alignment. The rail provides a highly rigid, very straight line. However, even if the rail is mounted on a granite surface for stability, positioning the components on the rail adds an intermediate mounting component which is often inadequate to use as a reference in highly precise optical systems. This problem is particularly complicated when the optics includes reflectors or has a very long axial extent such that the parts cannot be mounted on a single rail.

Furthermore, in optical systems comprising many components, it is often necessary to replace a component due to surface damage which may result from cleaning, or in order to vary the optics of the system. Replacement of components can require many hours of realignment.

Thus, in general, in complicated optical systems components are usually each individually aligned and component replacement requires realignment of the entire system or at least of the part being replaced.

SUMMARY OF THE INVENTION

It is an aspect of some preferred embodiments of the present invention that in an optical system comprising many components, wherein the components are positioned on a rail which is positioned on a very flat surface, vertical reference of the components is to the flat surface, although they are clamped to the rail.

In preferred embodiments of this aspect, an optical alignment and mounting system for optical components comprises:

a flat surface which provides a vertical reference for the components;

a rail mounted on the flat surface on which the components are mounted and which

provides a horizontal reference.

In a preferred embodiment of the invention, the rail has an inward sloping side. and a second side. The component is preferably mounted on a mounting platform which has an incline matching the inward sloping side, such that the platform and the rail mate when the platform is mounted. Furthermore, the mounting platform incorporates a mounting device which has a very flat base that sits on the flat surface. Preferably, the mounting platform includes a movable element which, when urged against the second side forces the platform downward and against the sloping side, such that the mounting platform is forced against (and referenced to) the flat surface. It should be noted in this regard that it is also referenced to the linear intersection of the incline and the flat surface, such that this line forms a reference for the mounted components.

An aspect of some preferred embodiments of the present invention is that in an optical system comprising many components, it is possible to replace some "factory-aligned" components with other "factory-aligned" components without the need for vertical or horizontal realignment, as the new components are vertically referenced to the flat surface and in particular to the line of intersection of the flat surface and the incline.

There is thus provided, in accordance with a preferred embodiment of the invention, an optical alignment and mounting system comprising:

a mounting element on which at least one optical component is mounted;

a flat surface which provides a vertical reference for the mounting element;

a rail mounted on the flat surface on which the mounting element is mounted and which provides a horizontal reference for the mounting element.

Preferably, the mounting element has a bottom surface at least part of which is flat and a pressure element that urges the bottom surface against the flat surface to provide the vertical reference. Preferably, the pressure element presses against the rail and the mounting element to urge the mounting element against the flat surface.

Preferably, the rail has a sloping side. and a second side and wherein the mounting element has an inclined surface with a matching sloping side, such that the two sloping sides mate when the mounting element is mounted on the rail. Preferably, the pressure element urges the inclined side and the sloping surfaces together such that the mounting element is urged toward the surface such that the intersection between the plane of the sloping side and the flat surface provide a directional and horizontal reference for the mounting element. Preferably, the pressure element presses against the rail and the mounting element to urge the mounting element against the flat surface.

In a preferred embodiment of the invention the second side is a sloping side and the pressure element has a matching sloping side that is urged against the second side, such that the pressure element slides along the sloping side toward the flat surface. Preferably, the pressure element and the mounting element have matching surfaces, such that the downward sliding pressure element presses the matching surfaces together to urge the mounting element toward the flat surface.

In a preferred embodiment of the invention, the mounting element and the optical component have a give spatial relationship.

There is further provided, in accordance with a preferred embodiment of the invention a method of replacing a component in an optical system having at least one optical component mounted in accordance with the invention, comprising:

removing the component and mounting element from the rail; and

replacing it with a different functionally identical components and mounting element having the given spatial relationship.

Preferably, the mounting element has a reference surface and the method includes:

placing a placing a reference holder at the reference surface prior to removing the component, and wherein replacing comprises placing the different mounting element on the rail with its reference surface against the holder.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more clearly understood from the following detailed description of the preferred embodiments of the invention and from the attached drawings, in which same number designations are maintained throughout the figures for each element and in which:

Fig. 1 is a schematic exploded illustration of the basic components of an optical alignment and mounting system, in accordance with a preferred embodiment of the invention;

Figs. 2A-2C are schematic illustrations of the consecutive steps in mounting components of the optical alignment and mounting system, in accordance with a preferred embodiment of the invention;

Fig. 3A is a schematic cross-sectional view of the optical alignment and mounting system, in accordance with a preferred embodiment of the invention;

Figs. 3B and 3C are schematic force diagrams in the optical alignment and mounting system, in accordance with a preferred embodiment of the invention; and

Figs. 4A and 4B are schematic illustrations of the consecutive steps in replacing components of the optical alignment and mounting system, in accordance with a preferred embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Reference is now made to Fig. 1, which is a schematic illustration of the basic components of an optical alignment and mounting system 10, in accordance with a preferred embodiment of the invention. Fig. 1 illustrates a guide in the form of a rail 12, preferably, of a highly rigid material, having sides 14 and 16 which are sloped inward. Sides 14 and 16 form an angle 18 with a base 19. Rail 12 further comprises a top surface 13. Preferably, and as shown, both sides 14 and 16 form the same angle with base 19. However, the sides may slope at different angles.

Fig. 1 also illustrates a mounting element 20, preferably, of a highly rigid material, having sides 30 and 50. Preferably, the inner portion of side 30 comprises an incline 36 at an angle 38. Preferably, the sum of angle 38 of mounting element 20 and angle 18 of rail 12 equals 180^{o} such that the two mate. Preferably a small cut-out and a vertical drop 40 to a base 39 are provided such that there is no interference at corners when mounting element 20 is mounted on rail 12, as described below.

Preferably, the inner portion of side 50 comprises vertical drop 54, a small outward step 56 and a second, smaller vertical drop 58 Preferably, side 50 includes a threaded hole 52. Side 50 further comprises a base 59 which is preferably coplanar with base 39.

Preferably, mounting element 20 further comprises a top 21, two alignment holes 22 located on top 21 and a mounting hole 24 or other mounting element, for a mounting screw, preferably including a centering element, at the center of top 21. Mounting element 20 further comprises a bottom surface 25 of top 21. Alternatively, the alignment holes may be replaced by additional mounting holes.

Fig. 1 also illustrates a pressure element 60 in perspective. Element 60, preferably, of a highly rigid material, comprises sides 62 and 72, a base 70 and a top 80. Preferably, side 62 includes a vertical drop 63, a step portion 66 and a second vertical drop 68. Preferably, side 62 includes a round socket 64, formed in vertical drop 63. Socket 64 does not go through the width of pressure element 60. Preferably, the bottom of socket 64 is composed of a very hard material. Preferably, side 72 is constructed as follows: an incline 73 at an angle 74 with base 70 and a small vertical drop 76. Preferably, angle 74 of element 60 and angle 18 of rail 12 form 180^{o}.

Fig. 1 also illustrates a view of pressure element 60 from side 72. Preferably, incline 73 is formed with a generally vertical slot 78.

Fig. 1 also illustrates a bolt 90 and a nut 92. Bold 90 is threaded to mate with hole 52 and the end of bolt 90 is preferably formed with a round protuberance 94, although other forms of beveled or chamfered protuberance may be used.

Finally, Fig. 1 also illustrates an optical component 100, such as a lens, reflector or beam splitter or other element, having a base 106. Base 106 comprises an attachment hole and socket 108 (configured to mate with element 24 of mounting element 20) and two pins 110 (made to fit onto alignment holes 22 of mounting element 20). Optical component 100 further comprises a left-right alignment screw 104 and an up-down alignment screw 102. While only left-right and up-down alignment screws are shown for simplicity, additional adjustments such as angular and axial position adjustments may be provided, as are well known in the art.

Reference is now made to Figs. 2A-2C which are schematic illustrations of the consecutive steps in mounting components of optical alignment and mounting system 10, in accordance with a preferred embodiment of the invention. For ease of illustration, no optical element is shown in Figs. 2A and 2B on mounting element 20; however, in practice, one would generally be attached thereto, before mounting on the rail, as shown in Fig. 2C

Preferably, as a first step, schematically illustrated in Fig. 2A, mounting element 20 is placed across rail 12 at a desired location. Bolt 90 is placed in screw hole 52 of mounting element 20, and nut 92 is screwed on bolt 90.

Preferably, as a second step, schematically illustrated in Fig. 2B, element 60 is placed between side 14 of rail 12 and inner side 50 of mounting element 20. Preferably, bolt 90 is screwed as far as possible into socket 64 of vice 60 and nut 92 is tightened.

Reference is now made to Fig. 3A which is a schematic cross-sectional view of the optical alignment and mounting system, in accordance with a preferred embodiment of the invention. As nut 92 is tightened, a force F (Fig. 3B) in the horizontal direction is applied by between element 60 and rail 12 at inclined surfaces 14, 73. A similar force is also applied between rail 12 and mounting part 20 at inclined surfaces 16, 36.

Reference is now made Figs. 3B and 3C which are schematic force diagram of a force R, and a reaction of rail 12 at point of contact 96. Forces F and R, in the horizontal direction, may be replaced by compression components, perpendicular to incline 73 and sliding components, parallel to incline 73. The shear components cause a sliding motion, with element 60 sliding down until step 66 of vice 60 sits on step 56 of mounting part 20. As the bolt is further tightened element 60 pushes down on step 56, forcing mounting element 20

down until base 59 of mounting part 20 is pressed against a flat surface 93 (Fig. 3A) on which rail 12 is mounted. Of course the other side of mounting element 20 is also urged toward the rail and downward toward surface 93. Thus, mounting part 20 is referenced to flat surface 93.

Base 70 of element 60 does not reach flat surface 93. Similarly, there is a clearance between top surface 13 of rail 12 and bottom surface 25 of mounting element 20. Thus, bases 39 and 59 sit on surface 93 and the entire mounting element is referenced to flat surface 93 and to the line 95 formed by the intersection of incline 16 and surface 93.

An optical component mounted on mounting element 20, schematically illustrated in Fig. 2C, is thus aligned, with respect to flat surface 93 and line 95, in all three angular and in vertical and horizontal directions. Such components may be factory aligned and are thus interchangeable for mounting on rail 12, without additional alignment. Only the axial position along rail needs be set.

In a preferred embodiment of the invention, components mounted on mounting elements 20 may be exactly characterized with respect to their alignment respective to surface 93 and line 95, without actually aligning them each time such optical component is installed in a system.

Assume for example, optical component 100 is a lens. A system containing lens 100 is aligned, while using the adjustment screws (and other adjustments not shown in the Figs.) to adjust the position and angle of the lens. The lens is now aligned with the system and also aligned with reference to surface 93 and intersection line 95. The lens may now be removed from the system and its characteristics measured on a test bench (referenced to surface 93 and intersection line 95 and preferably to one of the axially positioned faces indicated as 11 in Fig. 1) while it is mounted on a similar rail, in a test bench system. New lenses comprising elements 20 and optical components 100 may be prepared off-line as pre-aligned units according to spatial orientation and reference of the original component. It is now simple to interchange new optical elements that have been aligned off-line to the spatial orientation characterization of the original lens, simply by mounting the new pre-aligned lens on rail 12 in place of the original lens without having to readjust spatial alignment of the lens other than to set its axial position.

This process is repeated for all of the components mounted on the rails, to produce a complete set of spatial orientation characterizations and standard components for all components in the system.

When producing a new system similar to the original system, a new set of components is produced and aligned in accordance with this procedure. These components are mounted on

a rail and their exact axial position (along the rail) is determined experimentally, to match a desired characteristic of the system. However only the axial position need be adjusted. If two or more rails are used in a system, the rails are separately aligned and then are positioned with respect to each other to produce a desired optical system. This type of alignment, when initially manufacturing the system, may or may not be simpler than simply adjusting each optical element separately. However, it does result in simpler replacement of parts, as illustrated in Figs. 4A and 4B, described below. It should be noted that parts may need to be replaced in optical systems as a result of damage, such as damage caused by cleaning the parts (especially coated and front surface elements) or by overpowering the elements.

Reference is now made to Figs. 4A-4B which are schematic illustrations of the consecutive steps in replacing components of optical alignment and mounting system 10, in accordance with a preferred embodiment of the invention, in a manner that preserves axial distances along rail 12.

Preferably, as a first step, schematically illustrated in Fig. 4A, a replacement positioning element 120 is placed across rail 12, while being pressed as tightly as possible to face 11 of mounting element 20 of optical component 100 that is to be replaced. Replacement positioning element 120 is preferably substantially identical to mounting element 20, however, it does not generally bear any optical component and is used only for positioning of other components.

Preferably, as a second step, schematically illustrated in Fig. 4B, mounting part 20 of optical component 100 is removed from rail 12, by loosening nut 92 of bolt 90.

Preferably, as a third step (not shown), a new mounting element 20 of new optical component 100 is placed across rail 12, as tightly as possible to positioning element 120.

Preferably, as a fourth step (not shown), positioning element 120 is removed from rail 12. Again, although new optical component 100 has various alignment possibilities, no alignment is necessary, since the component is provided with preset horizontal vertical and angular orientation set in according to the characterization of the original optical component, and this alignment is preserved upon mounting the component to the rail as described above. Thus, new optical component 100 is aligned upon installment. The placement of the old and new components against element 120 assures that the component is also replaced in the proper axial position in the system.

The present invention has been described using non-limiting detailed descriptions of preferred embodiments thereof that are provided by way of example and are not intended to limit the scope of the invention. Variations of embodiments described will occur to persons of

the art. For example, and without limitation, it is readily appreciated that the optical alignment and mounting system may comprise a number of mounting element and optical component units or a mounting element may be configured to accommodate more than one optical element. Furthermore, while flat sloping surfaces are ideal as the matching surface for alignment, other surfaces may be used. Furthermore, the terms "comprising," "comprise," include," and "including" or the like, shall mean, when used in the claims, "including but not necessarily limited to." The scope of the invention is limited only by the following claims:

CLAIMS

1. An optical alignment and mounting system comprising:

a mounting element on which at least one optical component is mounted;

a flat surface which provides a vertical reference for the mounting element;

a rail mounted on the flat surface on which the mounting element is mounted and which provides a horizontal reference for the mounting element.

2. A system according to claim 1 wherein the mounting element has a bottom surface at least part of which is flat and including a pressure element that urges the bottom surface against the flat surface to provide the vertical reference.

3. A system according to claim 2 wherein the pressure element presses against the rail and the mounting element to urge the mounting element against the flat surface.

4. A system according to claim 1 or claim 2 wherein the rail has a sloping side. and a second side and wherein the mounting element has an inclined surface with a matching sloping side, such that the two sloping sides mate when the mounting element is mounted on the rail.

5. A system according to claim 4 wherein the pressure element urges the inclined side and the sloping surfaces together such that the mounting element is urged toward the surface such that the intersection between the plane of the sloping side and the flat surface provide a directional and horizontal reference for the mounting element.

6. A system according to claim 5 wherein the pressure element presses against the rail and the mounting element to urge the mounting element against the flat surface.

7. A system according to claim 3 or claim 6 wherein the second side is a sloping side and the pressure element has a matching sloping side that is urged against the second side, such that the pressure element slides along the sloping side toward the flat surface.

8. A system according to claim 7 wherein the pressure element and the mounting element have matching surfaces, such that the downward sliding pressure element presses the

matching surfaces together to urge the mounting element toward the flat surface.

9. A system according to any of the preceding claims wherein the mounting element and the optical component have a give spatial relationship.

10. A method of replacing a component in an optical system having at least one optical component mounted in accordance with claim 9, comprising:

removing the component and mounting element from the rail; and

replacing it with a different functionally identical components and mounting element having the same spatial relationship.

11. A method according to claim 10 wherein the mounting element has a reference surface and including:

placing a placing a reference holder at the reference surface prior to removing the component, and wherein replacing comprises placing the different mounting element on the rail with its reference surface against the holder.

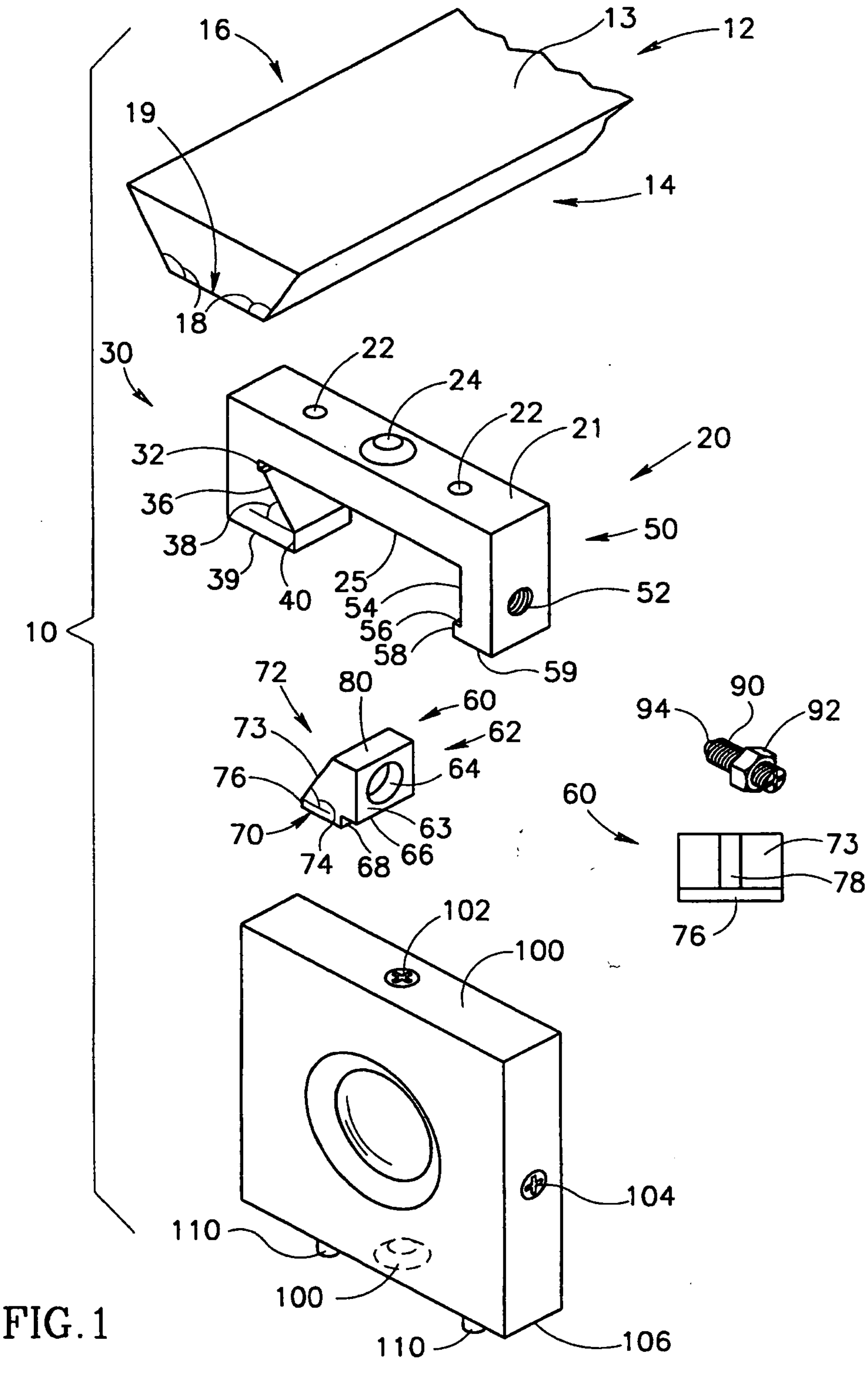
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FIG. 1

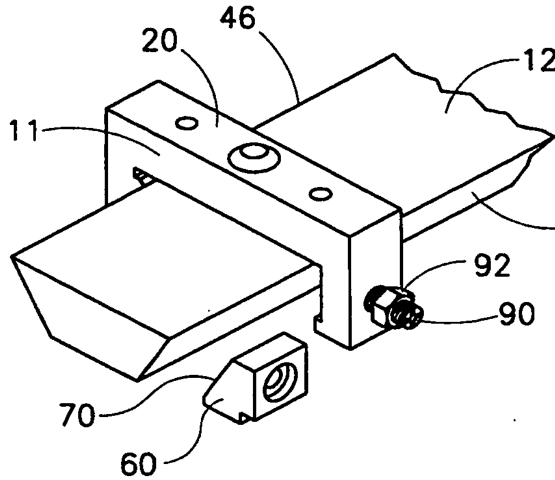

FIG.2A

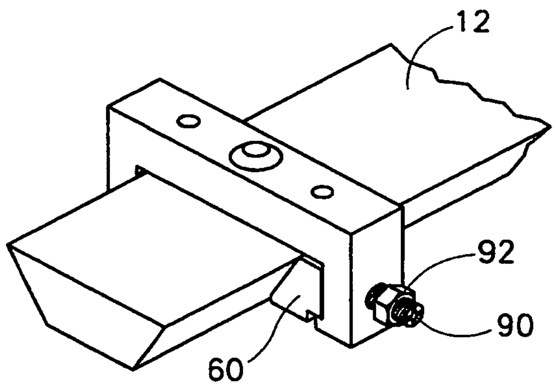

FIG.2B

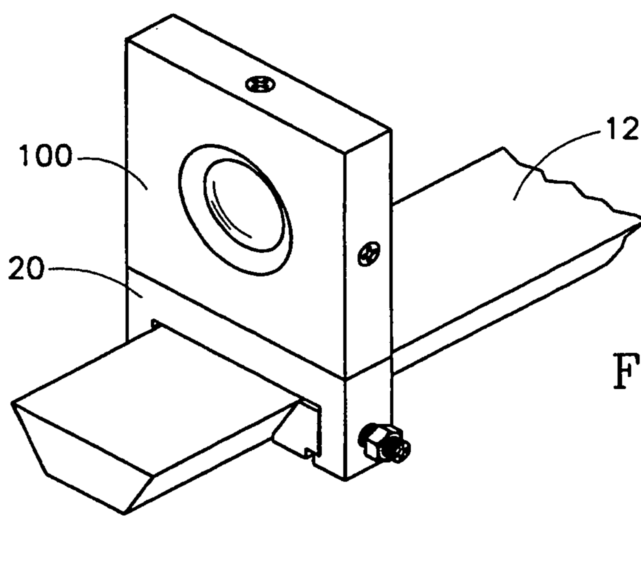

FIG.2C

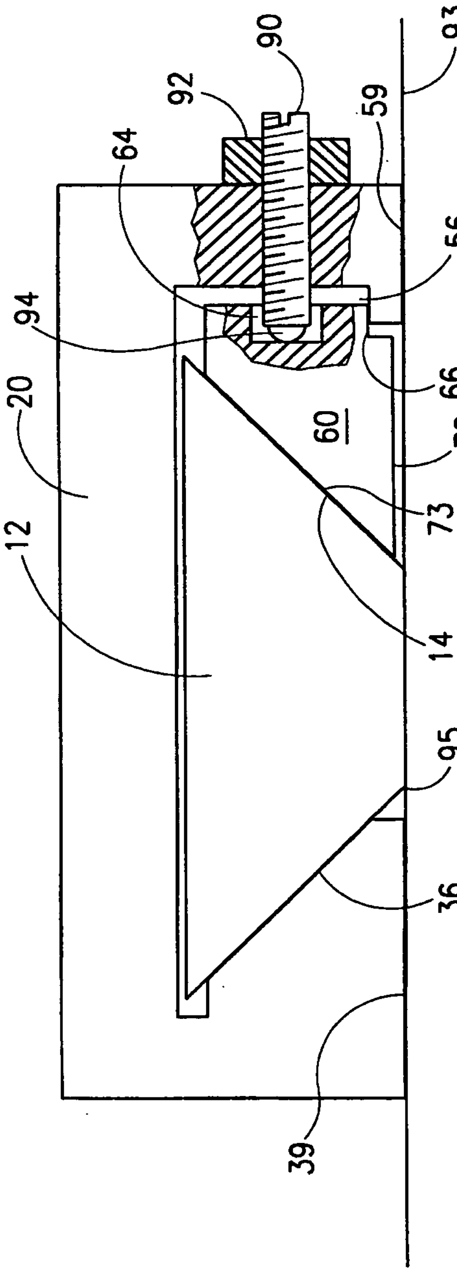

FIG.3A

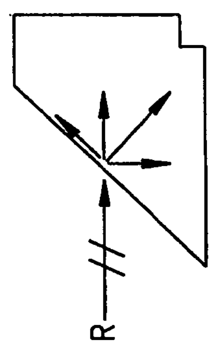

FIG.3C

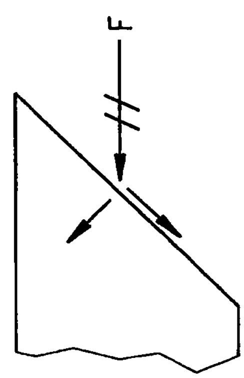

FIG.3B

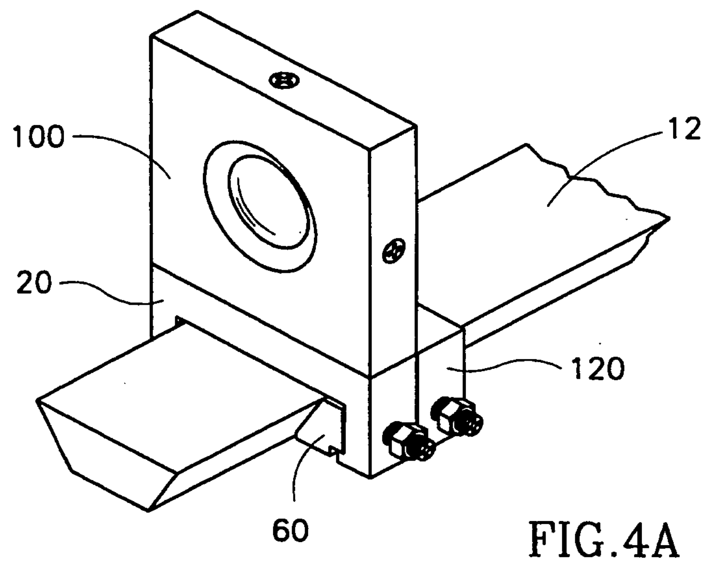

FIG.4A

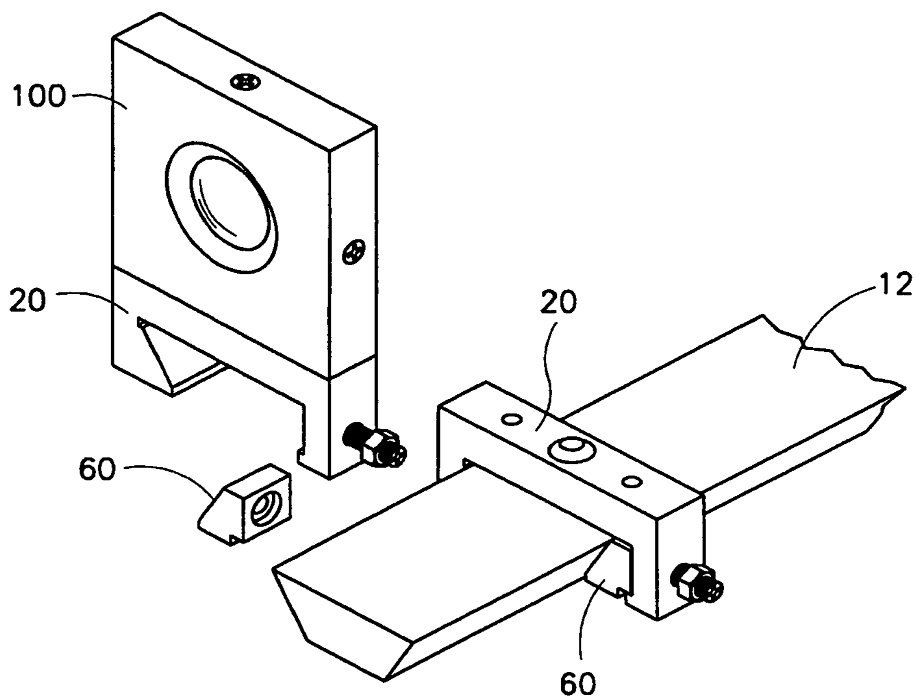

FIG.4B

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/01763

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01M11/04 G02B7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01M G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 574 468 A (HERMAN THOMAS S) 13 April 1971 (1971-04-13) column 3, line 25 -column 4, line 29; claims 1,4; figures 2-5	1-11
X	FR 2 402 799 A (THOMSON CSF) 6 April 1979 (1979-04-06) page 2, line 25 -page 4, line 18 page 5, line 22 - line 27; figure 1	1-9
X	US 5 194 993 A (BEDZYK MARK) 16 March 1993 (1993-03-16) column 4, line 20 - line 68 column 7, line 33 - line 62; figures 2,3	1-3,9-11

☐ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 November 1999	16/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hylla, W

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Intr ional Application No
PCT/EP 99/01763

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 3574468	A	13-04-1971	DE	1957064	A	19-05-1971
			GB	1276887	A	07-06-1972
			GB	1276888	A	07-06-1972
FR 2402799	A	06-04-1979	NONE			
US 5194993	A	16-03-1993	DE	69211327	D	11-07-1996
			DE	69211327	T	02-01-1997
			DE	69215208	D	19-12-1996
			DE	69215208	T	22-05-1997
			EP	0558735	A	08-09-1993
			EP	0558743	A	08-09-1993
			JP	6502935	T	31-03-1994
			JP	6502936	T	31-03-1994
			WO	9306514	A	01-04-1993
			WO	9306515	A	01-04-1993
			US	5220460	A	15-06-1993
			US	5210648	A	11-05-1993